Room Temperature Superconducting System (RTSC) for use on a Hybrid Aerospace-Undersea Craft (HAUC)

(EXPL-02, 3003343); (EXPL-02, AIAA-2019-0869)

Dr. Salvatore Cezar Pais, Ph.D.

Department of the Navy / NAVAIR / NAWCAD

2019 AIAA SciTech Forum and Exposition, January 7 - 11

San Diego, CA

RTSC for use on a HAUC
- **Quantum Fields Fluctuations**

- Everything that surrounds us, ourselves included, can be described as **macroscopic collections of fluctuations**, vibrations, oscillations **in quantum mechanical fields.**
- Under certain conditions, such as the coupling of high frequency axial spin with high frequency vibrations of electrically charged systems, the rules and special effects of quantum field behavior also apply to macroscopic physical entities.
- Consider that we are immersed in an ocean of energy, the **vacuum energy state (VES)**, yet ordinarily we seem not to interact with it. This is because under normal circumstances (at or near equilibrium), the vacuum state is homogeneous, isotropic, Lorentz invariant, in other words it is symmetric. **Break this symmetry (far-from-equilibrium),** and strong interactions with the vacuum energy state become possible, thus affecting the manner in which the collective fields exchange energy with one another.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **VACUUM ENERGY STATE (VES)**

- Aggregate/collective state (structure) comprised of the superposition of all quantum fields' fluctuations permeating the spacetime continuum.
- Matter, energy and spacetime are emergent constructs which arise out of a fundamental framework, the foundational structure that is the VES.
- Artificially generated, high energy, electromagnetic (EM) fields interact strongly with the VES – inducing strong interactions between the VES fields, based on the mechanism of transfer of vibrational energy between the fields, further inducing local fluctuations in adjacent quantum fields which permeate spacetime. These VES fields may or may not be electromagnetic in nature.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Solving the "Vacuum Catastrophe"**

- QFT and GR give 120 orders of magnitude discrepancy in Cosmological Constant value - conundrum may source from 'Planck Length' (10^-35 m)
- $\mathbf{h^* \omega \sim k T}$ (with T ~ 2.7 deg. K for 'outer-space')
- *Equivalence of 'Planck' Vibrational Energy with 'Boltzmann' Thermal energy results in '**space-cell**' configuration, with attributes:*
- *Vib. Freq.* ~ 10^12 (1/sec); Char. Length ~ 10^(-4) m; Vol. (space-cell) ~ 10^(-12) m^3
- *Vol. (observable Universe)* ~ 10^81 m^3 ; Energy (obs. Univ.) ~ 10^71 Joules (based on Vib. Freq. of space-cell); Number of Space-Cells (obs. Univ.) ~ 10^93
- Simple calculation results in Vacuum mass density of 10^(-27) kg/m^3, in good agreement with experimental data obtained from Planck satellite (WMAP as well).
- ***Energy Density tells Spacetime how to fluctuate, and Spacetime tells Energy Density how to propagate.*** (Key Evolution of John Archibald Wheeler's profound statement on Einstein's Theory of Relativity)

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Vacuum Energy Polarization**

- **Investigation of the quantum vacuum as a source of propulsion** estimated the very short scales of time and distance (and hence the high energies) over which the quantum vacuum must be interacted with for extracting enough propulsive energy for relativistic interstellar flight.
- it was suggested that **a system's inertia may be a consequence of quantum vacuum electromagnetic behavior**, therefore by polarizing the vacuum in the proximity of the system, inertial mass reduction may be achieved.
- Polarization of the local vacuum energy state is analogous to **manipulation/modification of the local spacetime energy density**, so as to reduce the resistance to motion of a propagating craft – **extreme speeds possible**.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **High Energy EM Fields**

- For accelerated spin / accelerated vibration of charged matter, we can write for the maximum EM energy flux (time rate of change of EM energy transfer per unit surface area):

$$S_{max} = f_G (\sigma^2 / \varepsilon_0) [(R_v \nu^2) t_{op}]$$

- If we consider adding to the equation representing simple harmonic motion an "energy/momentum-pumping" (negative damping) term (bv), endemic of system acceleration, where b is a constant and v is (dx/dt), namely the speed of a vibrating mass (m), under the condition [$\Omega = (b/2m) >> \Omega_0$ (natural frequency of vibration)]:

$$S_{max} \approx (Q^2 / \varepsilon_0) (R_v^2 / R_s^5) \Omega [\exp (2 \Omega t)]$$

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Inertial Mass Modification**

- **The resultant high energy EM flux**, on the order of **10^{33} Watts/m^2**, and possibly much higher, when concentrated in a small area around the contour of the object (craft) can generate **energy densities of 10^{25} Joules/m^3**, commensurate with **Schwinger electric field values for vacuum polarization**. This physical condition is representative of the QED vacuum breakdown and is indicative of possible inertia control by altering the local vacuum energy density.
- *If we consider cosmic space as a superfluid medium, we may be able to say that the IMRD device has the capability of inducing a local phase transition from a turbulent regime to a laminar regime, thus allowing for "smooth sailing" of a hybrid craft (HAUC) through the specially conditioned vacuum of Space.*
- *This is a vacuum that has undergone **macroscopic quantum coherence**, locally, around the craft. As a result, **the craft experiences "suction" into the conditioned vacuum.***

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Macroscopic Quantum Coherence**

- **Quantum field theory teaches that everything can be described in quantum mechanical terms.** The complex interactions between a physical system and its surroundings (environment), disrupt the quantum mechanical nature of a system and render it classical under ordinary observation. This process is known as decoherence.
- *We can retard (delay) decoherence (and possibly even suppress it – namely decouple a physical system from the environment) by **accelerated spin and/or accelerated vibration of electrically charged matter under rapid acceleration transients.***
- *This may be the very condition to achieve a state of **macroscopic quantum coherence**, the idea being that we never let the system achieve thermodynamic equilibrium, by constantly delaying the onset of relaxation to equilibrium (hence the production of maximal entropy is delayed). The system may "violently" react by generating "anomalous" emergent phenomena, such as, but not limited to, inertial mass reduction.*

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Prigogine Effect**

- **The Prigogine effect** teaches us that depending on three conditions, a chaotic system, namely the 'soup' of fluctuations that make up the vacuum energy state, can self-organize into an orderly state, equivalent to the state of macroscopic quantum coherence (**From Chaos, Order**).
- *These conditions are the existence of a **highly non-linear medium** (the cosmic superfluid), **an abrupt departure far-from-thermodynamic equilibrium** (the accelerated spin/vibration of charged matter) and last but not least **an energy flux (the generated EM energy flux)** to maintain the process of self-organization (order from chaos).*
- *All three conditions for the Prigogine effect are met in our application, thus it can be argued that a possible theoretical path toward **inertial mass reduction induced by macroscopic quantum coherence** is herein established.*

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
Hayasaka – Takeuchi Experiment (PRL, Dec.'89)

- Hayasaka and Takeuchi report the **anomalous weight reduction of gyroscopes for right rotations only**. At the time, the authors could not elucidate the physics behind these anomalous results. **Several <u>null result experiments</u>** followed, which declared the Hayasaka et al. results null and void, or at least questionable.

- $$\Delta W_R(\omega) = -\,2 \times 10^{-10}\, M\, r_{eq}\, \omega \quad (kg\ m\ s^{-2})$$

- *Based on this result –* ***possibility of inertial mass reduction****:*

- $$\Delta W_R(\nu) = -\, f_{ep}\, M\, A_\nu\, \nu \quad (kg\ m\ s^{-2})$$

- *where* $\mathbf{f_{ep}}$ ***is the Fokker-Planck electron-proton thermal equilibration rate*** *under the Vacuum state condition.*

- *It is possible that the* ***gyro-rotor had residual electric charge.***

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Proposed Experiment**

- Propose that a similar experiment to the Hayasaka et al. experiment be executed under the following conditions: a pressure of 10^{-4} to 10^{-2} Pa (ultra-high vacuum in test chamber is preferred) in the evacuated chamber, a gyro-spin frequency range of 1.3×10^4 to 10^5 rpm,

- Most importantly, under high rates of change of rotational and vibrational acceleration-deceleration-acceleration (to ensure abrupt departure far-from-equilibrium).

- It is further suggested, that the gyro-rotor be electrically charged, with at least a unit order surface charge density. Moreover, execute the transient ramping up-down-up of the rotor charge.

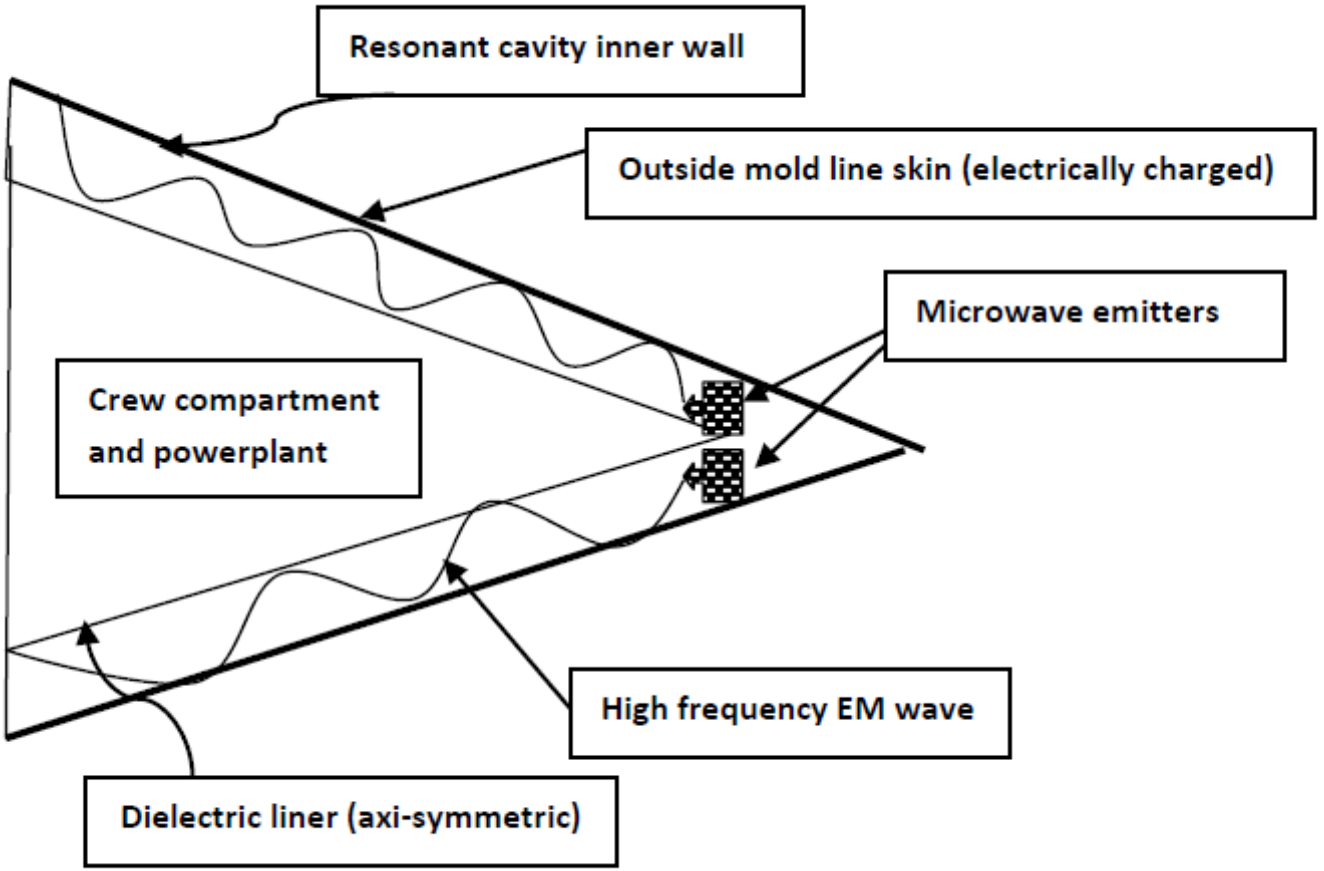
NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Hybrid Aerospace-Undersea Craft (HAUC)**

- It is possible to envision a hybrid aerospace / undersea craft (HAUC), which due to the physical mechanisms enabled with an inertial mass reduction device (IMRD), can function as a submersible craft capable of extreme underwater speeds (lack of water-skin friction) and enhanced stealth capabilities (non-linear scattering of RF and sonar signals).
- This hybrid craft would move with great ease through the air/space/water mediums, by being enclosed in a Vacuum plasma bubble/sheath, due to the coupled effects of EM field-induced air/water particles repulsion and Vacuum energy polarization.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **HAUC - configuration**



IMRD -Microwave Emitter configuration (Cross-sectional side view)

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC - **HAUC Summary**

- **It is possible to design a hybrid craft which by delivering vast amounts of electromagnetic energy flux in its close proximity can alter the spacetime energy density in that locality.** In this manner, the craft can move at extreme speeds, due to quantum electrodynamic Vacuum breakdown effects, which result in inertial mass reduction.

- **Controlled motion of electrically charged matter under accelerated vibration and/or accelerated spin and subjected to rapid acceleration-deceleration-acceleration transients, can be used in conjunction with nested EM fields (EM fields within EM fields) and the enablement of the Gertsenshtein effect, in order to manipulate / modify gravitational fields** for propulsion, or to provide novel methods of plasma confinement and compression for nuclear fusion research.

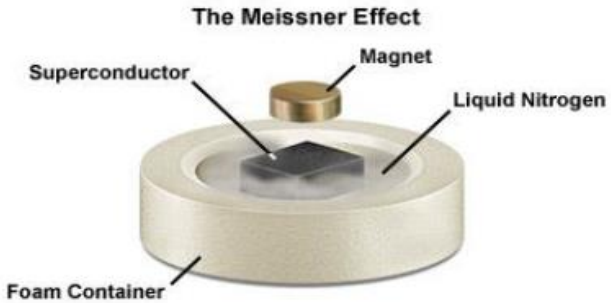
NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **Superconductivity**

There are three parameters which affect superconductivity, namely temperature, current density, and externally applied magnetic field strength. Physically, these parameters have in common one thing, which is the interactive motion of electric charges, namely electrons.

Control of this motion via vibration and/or spin of charged matter subjected to rapid acceleration transients (highly non-linear in nature) may lead to the achievement of room temperature superconductivity, especially if the charged matter is inhomogeneous.

The key to room temperature superconductivity is the enablement of local macroscopic quantum coherence, namely the ability of a macroscopic object to act as if quantum mechanical in nature exhibiting such phenomena as superposition, entanglement and tunneling.



MEISSNER EFFECT - The expulsion of magnetic field lines by a superconducting material inducing superconductor levitation. This effect is endemic of all known superconductors and is essential for the emergence of superconductivity as a unique macroscopic quantum state in condensed matter physics. (Public Domain Image)

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC - **RTSC Proposal**

- **The achievement of room temperature superconductivity (RTSC) represents a highly disruptive technology, capable of a total paradigm change in Science and Technology,** rather than just a paradigm shift. Hence, its military and commercial value is considerable.
- It is important to realize that internal heating within any system enclosure can be greatly reduced by room temperature (300 deg. Kelvin and higher) superconducting wiring, which would allow for **lossless transmission of electrical power t**o its subsystems
- . A room-temperature superconductor is a material that is capable of exhibiting superconductivity at operating temperatures of or above 25 deg. C (approx. 300 deg. K). Several materials have been reported to be room-temperature superconductors, although none of these reports has been confirmed nor properly acknowledged by the mainstream condensed matter physics community. However, **the concept at hand argues that, instead of concentrating on the chemical structure of such materials which do not utilize any electrical or mechanical manipulation, room temperature superconductivity (RTSC) in a manipulated current-carrying special composite wire may be achieved.**

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **RTSC Proposal - continued**

- What if **all you need to do, in order to make a special composite metallic wire be superconductive (SC) at room temperature, is to make it abruptly vibrate, while running a pulsed current through it**, just like 'plucking' a guitar string, intermittently. The current must be pulsed for maximum effect, moreover **the current is pulsed through the wire at the resonant vibration frequency.**

- The special composite metal wire is composed of a bulk (core) insulator (such as Teflon, or any other non-conductive polymer) with a 'thin' coating of a normal or poor metal (such as Aluminum (Al) or PZT ceramic), of a thickness on the order of the London penetration depth (microns - but possibly much thicker, based on experiments to be performed), given an externally applied magnetic field. Arguably, **this wire configuration may be termed an unconventional superconductor**, since the RTSC supercurrent may be generated along the interface (boundary) between the normal metal and the insulator portions of the wire.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **RTSC Wire Configurations**

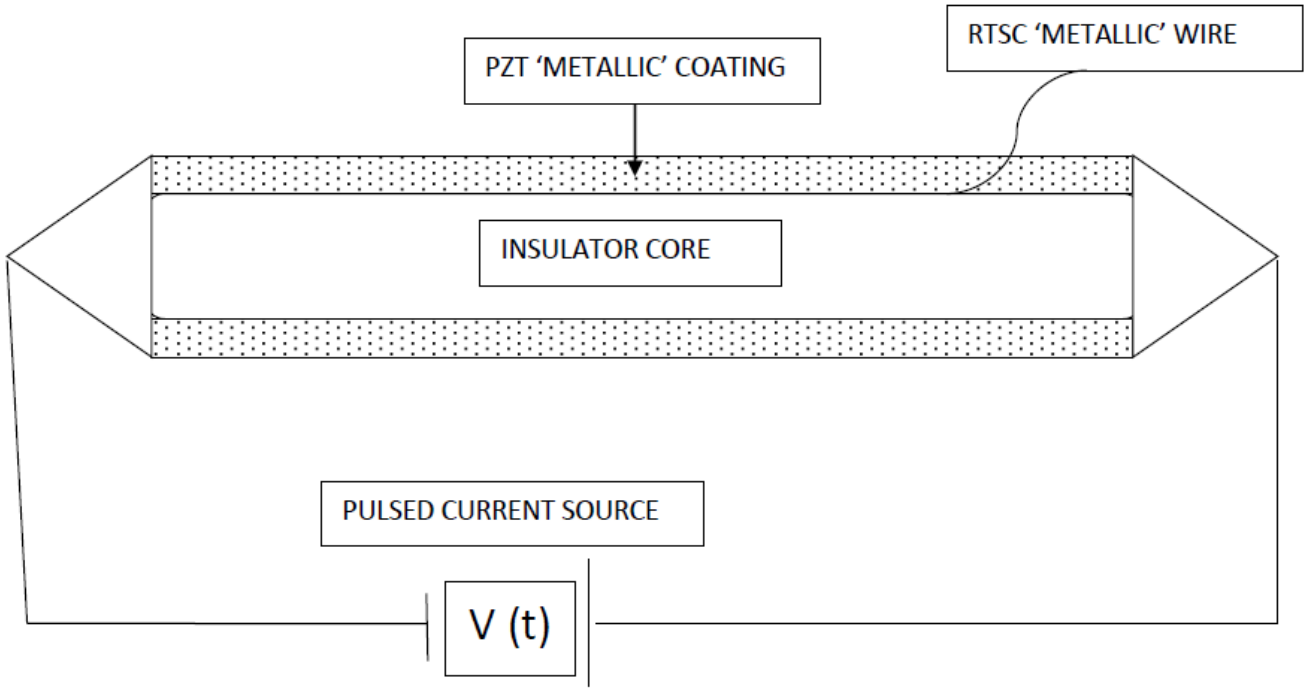


FIGURE 1 - CROSS-SECTIONAL VIEW OF RTSC WIRE

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- **RTSC Wire Configurations**

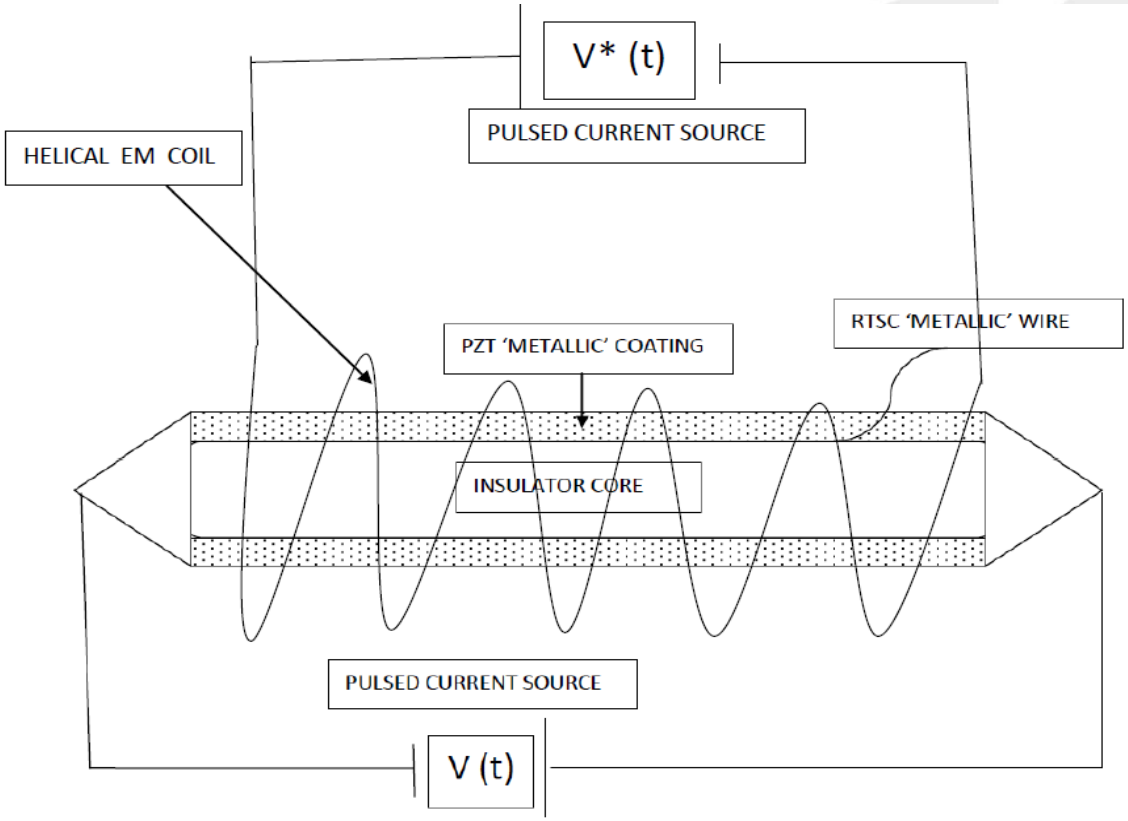


FIGURE 2 – ALTERNATIVE CROSS-SECTIONAL CONFIGURATION OF RTSC WIRE

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- Mathematical Formalism of RTSC Concept

Consider the fact, that in a superconductor, the introduction of an electric field will accelerate the superconducting charge carriers (electrons). This can be represented by the phenomenological London theory, by using a simple Newtonian formalism, which can be expressed as:

$$d\mathbf{J} / dt = [(n_s q_s^2)/m_s] \mathbf{E} \quad (2)$$

, where **J** is the current density, and **E** is the applied electric field.

Since we can write $\mathbf{J} = n_s q_s \mathbf{v}$, where **v** is the velocity of the electrons, given the fact that for accelerated vibration we have $(dv/dt)_{max} = R_\omega \omega^2$, where R_ω is the vibration amplitude and ω is the angular frequency of vibration (given a simple harmonic motion treatment).

Therefore, from equation 2, we obtain the relation:

$$m_s \sim q_s^2 / \omega^2 \quad (3)$$

This expression indicates that if the superconducting wire is vibrated then the superconducting charge carrier mass is inversely proportional to the vibration frequency squared. Thus as the vibration frequency is increased the mass of the SC carriers will decrease, which means that the electron transport through the ion lattice is facilitated to a very high degree as the wire is accelerated in vibration. It can be argued that for high vibration frequencies this is analogous to zero electrical resistance.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC

- **RTSC Concept – Isotope Effect (experimental verification)**

It is of interest to consider the Isotope effect in superconductors [18], for which the critical temperature T_c can be scaled with (M^{-a}), where the exponent (a) can be higher than 0.5 for unconventional superconductors (high T_c superconductors such as YBCO); for the sake of simplicity we have a = 1, where M is the ionic mass.

Considering a classical Newtonian second law expression using the Lorentz electromagnetic force (under accelerating vibration of frequency Ω), we can relate the vibrating mass (M) with its vibrating charge (Q), in that (M) becomes directly proportional to the square of the ratio (Q / Ω).

Therefore, it can be observed that the value of T_c can be directly proportional with the square of the vibrational frequency of the ionic mass, indicative of high T_c enablement, and hence RTSC possibility with accelerating vibration of the wire.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- Novel Interpretation of E = mc^2

$$m / E_T = \{[\mu_0 \mu H^2] [\varepsilon_0 \varepsilon E^2]\} / (E^2 H^2) \quad (5)$$

, where $[c^2 = 1 / (\mu_0 \mu \varepsilon_0 \varepsilon)]$, such that μ_0 and μ are the vacuum and non-vacuum magnetic permeabilities and ε_0 and ε are the vacuum and non-vacuum (dielectric constant) electric permitivities, respectively; in this case c is the speed of light in a non-vacuum medium (that is μ and ε are not equal to 1).

Given the fact that (S = EH), where S is the magnitude of the Poynting vector (EM energy flux), E and H are the electric and magnetic field strength respectively, and further taking into consideration that S is directly proportional to the angular frequency of spin or vibration (ω), as depicted in equation 1 of reference 11, then we can write:

$$m / E_T \sim 1 / \omega^2 \quad (6)$$

which reinforces the finding of equation 3, namely that the mass of an object is inversely proportional with the object's spin or vibration frequency squared.

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC
- Electron Pairing Mechanism

Imagine the ionic crystal lattice of the composite metallic wire, featuring a matrix of two rows and multiple columns of positive ions. Through this matrix, two fast electrons (pulsed current) move horizontally, a front electron and a rear electron.

Recall that the current is abruptly pulsed through the metallic portion of the wire, while the wire is abruptly vibrated. This means that the lattice ions will be moving furiously toward each other, in the direction of wire vibration which for the sake of simplicity, say that is vertical in motion (the frequency of pulsed current may be higher than the frequency of wire vibration). It is important to realize that for high frequencies of wire vibration ($>10^{12}$ Hz), the thermal energy given by the Boltzmann relation ($E = kT$), where k is the Boltzmann constant (8.62×10^{-5} eV/^{0}K) and T is room temperature (300 deg. K), is far exceeded by the vibration energy of the wire. This means that the most important fluctuations are those of the lattice ions themselves, induced by the wire vibration. Further imagine that as the top and bottom lattice ions approach each other vigorously, they just as strongly rebound due to the Coulomb repulsion force acting between them.

Think of the front electron as it approaches the gap between the two ions. Since the electron speed is determined by the pulsed current, the front electron is fast enough to pass through the ion gap and not collide with the lattice. However, as the two lattice ions approach each other (letting the front electron through), an enhanced positive charge region is formed between them.

It is this enhanced positive charge region which decelerates the front electron while accelerating the rear electron toward it. As the two electrons approach each other, they pair up, however at much higher energies than Cooper pair formation (10^{-3} eV).

Along this line of thought, the condition for the vibration energy to exceed the thermal energy and thus ensure that the coherence timescale is far higher than the decoherence timescale (possibly ensuring that macroscopic quantum coherence occurs), can be expressed as:

$$h^* \omega >> k T \qquad (7)$$

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

RTSC for use on a HAUC - **Conclusion**
- HAUC 'Foundational' Patent Awarded - US Patent # 10135366

- **Electron pairing is the keystone of superconductivity**, without which its physical mechanism cannot stand. **At high temperatures (RTSC) it is only the moderately strong non-linear electron-phonon (lattice vibrations) interactions that can induce electron pairing.** Arguably, **given the fact that** a **superconducting condensate is an electrically charged superfluid** and that ***the foundational structure of the Cosmos (the vacuum energy state) is superfluid in nature*** (Huang (MIT)'2016), **it may be possible to render ordinary matter as superconducting via electrodynamic manipulation.**

- The **Extremely high EM energy flux** values achieved with the concept at hand **can be used in the design of space systems** which could **deflect, re-direct and/or destroy asteroids**, such as Apophis (99942), on possibly dangerous trajectories close to Earth in 2029 and 2036. Such a system is the subject of US Patent Application number US 2017/0025935 A1, titled "Electromagnetic Field Generator and Method to Generate an Electromagnetic Field" **– US Patent # 10135366 was issued on November 20, 2018.**

NAVAIR Public Release 2018-854. Distribution Statement A - Approved for public release; distribution is unlimited

AIAA
Shaping the Future of Aerospace